NORTH TANK AREA (NPL SITE)
OPERABLE UNIT TO B 3001
DESIGN SUMMARY REPORT
TINKER AIR FORCE BASE
OKLAHOMA CITY, OKLAHOMA

INSTALLATION RESTORATION PROGRAM
PROJECT NO. WWYK88 – 0349B
SITE IDENTIFICATION NO. TINKER – ST03

FINAL

MARCH 1990

US Army Corps
of Engineers

Tulsa District

NORTH TANK AREA (NPL SITE)
OPERABLE UNIT OF BLDG. 3001
FLOATING FUEL AND CONTAMINATED SOIL
INTERIM ACTION
DESIGN SUMMARY REPORT

TINKER AIR FORCE BASE
INSTALLATION RESTORATION PROGRAM
PROJECT NO. WWYK 88-0349B
SITE NO. TINKER 01

PREPARED FOR:
ENVIRONMENTAL MANAGEMENT DIRECTORATE
DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OKLAHOMA CITY AIR LOGISTICS CENTER

PREPARED BY:
U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

FINAL
MARCH 1990

NORTH TANK AREA OPERABLE UNIT
DESIGN SUMMARY REPORT
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The North Tank Area is identified in the Federal Facilities Agreement (FFA) as an operable unit of the Building 3001 NPL site on Tinker Air Force Base. Remedial Investigations have been conducted under the Building 3001 Remedial Investigations. This report presents a summary of the site investigation, the options considered for interim remedial action, and the interim remedial action design.

The North Tank Area Operable Unit is immediately north of Building 3001. Building 3001 is located in the northeast portion of Tinker Air Force Base, Oklahoma. The site covers approximately 16,400 square feet and contains three buried tanks: a 235,000 gallon fuel oil tank, an active 20,000 gallon diesel tank, and a 500-600 gallon waste tank. A 13,000 gallon gasoline tank was removed in 1985. Due to leaking tanks, the area has a floating fuel plume on the perched groundwater table and fuel vapors in the soil. The perched groundwater aquifer is contaminated with benzene, toluene, and xylene (BTX) plumes that are contained within the Building 3001 Trichloroethylene (TCE) contaminant plume and will be addressed in the Building 3001 Final Remedial Action.

A hydrocarbon only pump and a water table depression pump will be used to remove the floating fuel layer. The vapor phase fuel will be removed by a vapor phase extraction system with horizontal extraction borings. The inactive tanks will be abandoned, cleaned, demolished and backfilled when vapor recovery is complete.

NORTH TANK AREA OPERABLE UNIT
INTERIM REMEDIAL ACTION
DESIGN SUMMARY REPORT
FEBRUARY 1990

1.0 PURPOSE. This report is issued to describe the planned interim remedial action for the North Tank Area (NTA) Operable Unit (OU), which consists of an underground tank area that has floating fuel product and fuel vapors above the groundwater, north of Building 3001 at Tinker Air Force Base (AFB), Oklahoma. This report also briefly describes the other interim remedial actions alternatives considered for this site.

2.0 GENERAL. The North Tank Area Operable Unit is located immediately to the north of Building 3001 on Tinker AFB. Building 3001 houses a large industrial complex where aircraft and jet engines are serviced, repaired, and/or upgraded. The United States Environmental Protection Agency (EPA) placed the Building 3001 site on the National Priorities List (NPL) of hazardous waste sites in 1987. The United States Air Force, the EPA, and the Oklahoma State Department of Health entered into a Federal Facilities Agreement (FFA) in December 1988 that outlines the procedures for remediating the NPL site on Tinker AFB. The FFA identifies the NTA as an OU to the NPL site in Part XI, Section B.1.(b)(2).

Remedial investigations (RI) have been conducted at the site by the Tulsa District Corps of Engineers (COE) to define and characterize the sources, extent, and magnitude of the contamination. These investigations are described in detail in the Building 3001 RI Report, (COE 1988), which is included in the Administrative Record. The investigations were performed as part of the Tinker AFB Installation Restoration Program (IRP). The investigations indicated that past activities within and in the vicinity of Building 3001 have resulted in contamination of the upper groundwater zones with industrial solvents, metals, and fuel products.

A Feasibility Study (FS), (COE 1989), was conducted in order to determine the appropriate action for remediating groundwater contamination at Building 3001.

The Building 3001 Proposed Plan, (COE 1990), for the groundwater contamination includes pumping and treatment of the contaminated groundwater. Removal of the floating fuel product must be completed prior to implementing final remedial action (RA) for the groundwater. Therefore, removal of the floating fuel product and vapors will be accomplished as an interim action prior to the Building 3001 RA.

A Risk Assessment, (COE 1988), determined that there was no significant short-term risk to human health and the environment. The long-term risk is minimal, however, interim remedial action is to be taken in order to insure that the operable unit will not pose any future risk.

3.0 SITE LOCATION. Tinker AFB is located in central Oklahoma,in the southeast portion of the Oklahoma City metropolitan area. It is adjacent to Midwest City to the north, Del City to the west, and Oklahoma City to the south and east. (See Figure 1). Building 3001 is located on the northeast corner of Tinker AFB. The NTA OU is located immediately north of Building 3001, as shown on Figure 2.

4.0 SITE DESCRIPTION. The North Tank Area covers approximately 16,400 square feet of grassed area. The area contains an inactive 235,000 gallon underground fuel oil tank (Tank Number 3404), an active 20,000 gallon underground diesel tank (Tank Number 3401), and an inactive 500-600 gallon underground waste tank. A 13,000 gallon gasoline tank (Tank Number 3405) was removed in 1985. A site plan with the location of the explorations is shown in Figure 3.

5.0 BACKGROUND. A. L. Burke Engineers installed 3 groundwater monitoring wells (MM-1, MM-2, and MM-3) during the initial underground storage tank investigations in October 1985 (ref. 1). During October 1986, February 1987, and March 1987 the COE installed 5 monitoring wells (1-26, 1-27, 1-30, 1-31, and 1-32) in further investigations to define the extent of the groundwater contamination. These wells indicated the presence of a perched aquifer at a depth of 15.0 to 16.0 feet below the ground surface. The hydraulic gradient is very low with the primary direction of flow being to the southeast.

The actions described for the NTA OU were in preliminary design before the FFA was signed. In order not to delay the project, EPA and OSHA agreed to grandfather the actions taken prior to the signing of the FFA. The design is near completion but, the construction has not begun. Tinker and the regulators determined that the design for the interim action should be summarized in a report.

6.0 SUMMARY OF INVESTIGATIONS. A summary of the subsurface, groundwater and soil investigations is given below. The Building 3001 RI, (COE, 1988), discusses the remedial investigations at the North Tank Area in more detail.

6.1 SUBSURFACE INVESTIGATIONS. Subsurface investigations were conducted throughout the area of Tinker AFB. The surficial soils in the area consist of residual and alluvial fine-grained soils. The northern section of the Base is dominated by Garber Sandstone while, the southern section is dominated

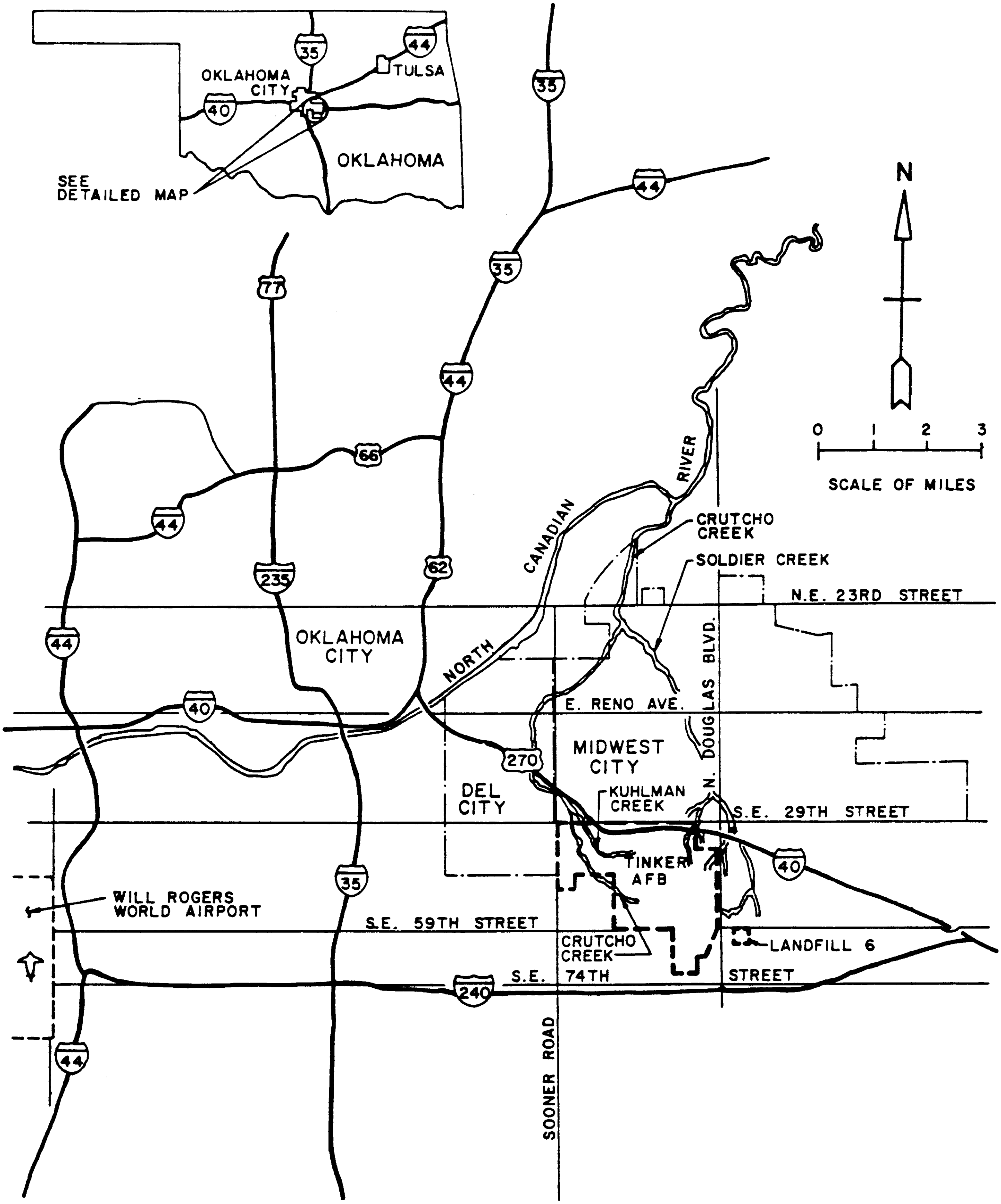


FIGURE 1
SITE VICINITY
TINKER AFB

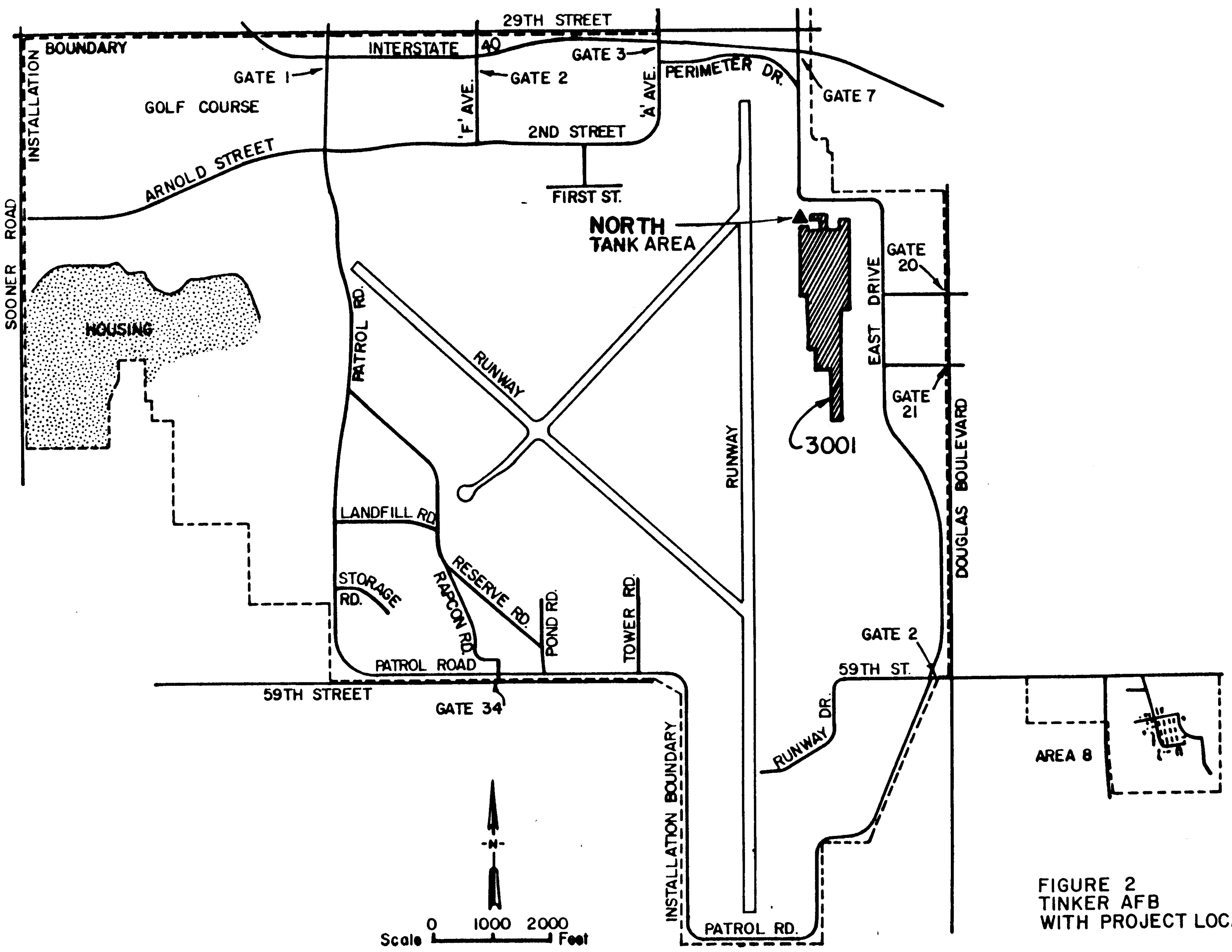


FIGURE 2
TINKER AFB
WITH PROJECT LOCATION

NORTH TANK AREA OPERABLE UNIT

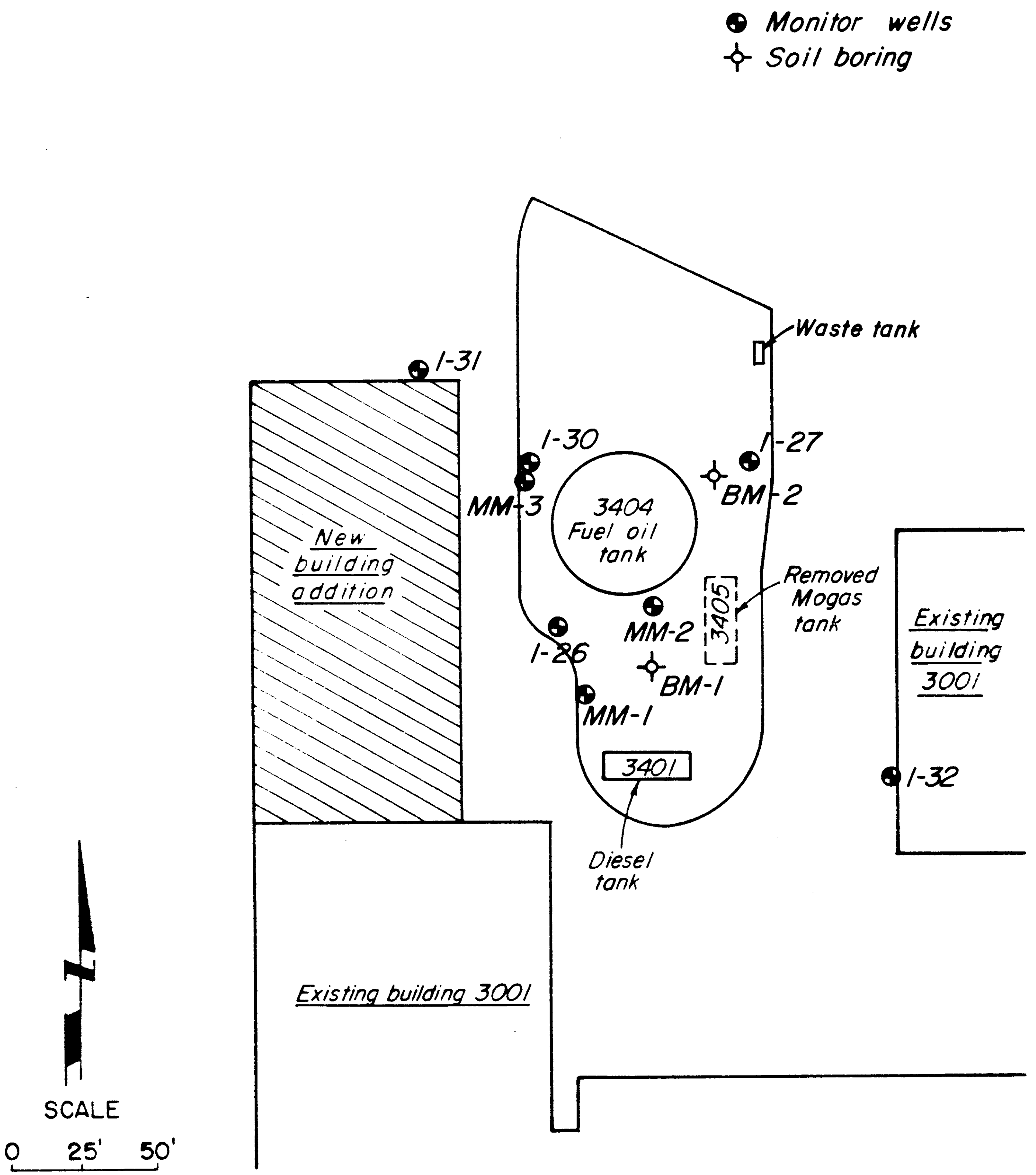


FIGURE 3
EXPLORATION LOCATIONS
TINKER AFB

by the Hennessey Group. Perched, top of regional, and regional groundwater aquifers are located beneath the site. The contamination in the North Tank Area is found in the perched aquifer only. The regional groundwater aquifer is a portion of the Garber-Wellington Aquifer (also known as the Central Oklahoma Aquifer).

There is a 1 to 3 feet thick layer of clay (CL) at or just below the surface covering most of the NTA. The clay is underlain with 2 to 6 feet of fine grained, medium density to loose sand (SC) that overlays a medium grained, medium density sand (SP) that is 1 to 3 feet thick through out the area. A fine grained sandstone (SS) is located at about 11 feet below the surface. It extends to a depth of about 30 feet in the NTA and is underlain with a soft, silty, blocky red shale. All of the monitoring wells at the NTA site are located in the perched aquifer. The screen intervals in the monitoring wells range in depth from 15 to 36 feet below the surface.

6.2. <u>GROUNDWATER INVESTIGATIONS.</u> Large amounts of fuel oil and some diesel fuel have been found floating above a perched groundwater table. Fuel depths of up to 15 feet have been detected in the monitoring wells. The fuel thickness contours (based on thicknesses on the monitoring wells) are shown in Figure 4. The estimated volume of fuel is 6,000 to 12,000 gallons. Although the grassy area covers an area of approximately 16,400 square feet the actual contamination plume covers approximately 25,200 square feet. Water samples from the wells indicate the water beneath the fuel is contaminated with benzene, toluene, and xylene (BTX). These contaminant plumes are contained within the Building 3001 TCE contaminant plume.

6.3. <u>SOIL INVESTIGATION.</u> Soil samples were collected near wells 1-26, 1-27, 1-29, 1-30 and 1-31. The samples collected near well 1-30 were analyzed for heavy metals, volatile organics, and fuel types. Low concentrations of Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Nickel (Ni), Lead (Pb), Selenium (Se), and Zinc (Zn) were detected in the samples. The lab analysis can be found in the Building 3001 Remedial Investigations report. Table 1 shows the volatile organics detected and the depth of detection in the samples from boring 1-30. Fuel oil with some diesel fuel was found in the depth range of 12.0 to 33.0 feet. Leakage occurred primarily from the bottom portions of the tank. This is indicated by the fact that the occurrence of fuel and the highest concentrations of fuel components were detected at 24 to 33 feet below the surface. Rise and fall of the perched groundwater during seasonal fluctuations distributed the floating fuel product in the materials above the water table. Samples collected near wells 1-26, 1-27, 1-29, and 1-31 were

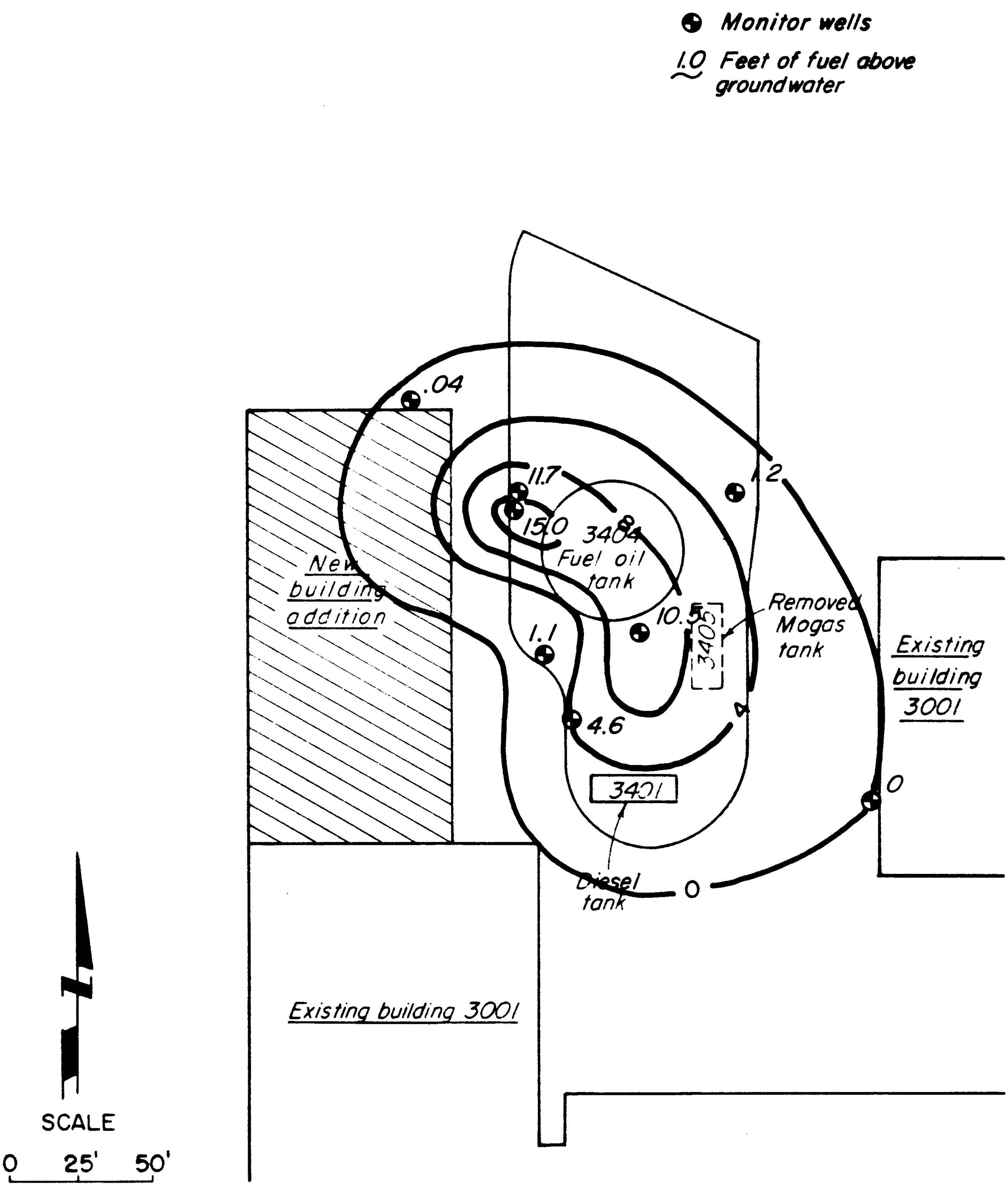


FIGURE 4
FUEL ISOPACH
TINKER AFB

tested for fuel. Fuel was also detected in areas of fill material placed during underground tank and utility construction.

TABLE 1
VOLATILE ORGANICS DETECTED IN SOIL SAMPLE
NORTH TANK AREA WELL 1-30

Compound	Maximum Concentration (mg/kg)	Depth(ft.)
Methylene Chloride	0.330	20.3
Acetone	9.96	24.7-25.2
Chlorobenzene	0.015	12.0-12.5
Ethylbenzene	10.13	27.7-28.2
Toluene	7.73	24.7-25.2
Xylene	31.00	24.7-25.2
Styrene	27.0	27.7-28.2

7. TECHNOLOGIES CONSIDERED FOR REMEDIATION OF THE NORTH TANK AREA. Several different technologies were assessed in the selection process to determine the recommended interim remedial action for this site. The remedial actions are listed below.

a. Free Floating Fuel Removal

b. Fuel Vapor Extraction

c. Capping of the North Tank Area with a low permeable cover.

d. Removing the fuel contaminated soil.

e. Pumping and treating the BTX groundwater.

f. Tank Abandonment.

7.1. ASSESSMENT OF REMEDIAL TECHNOLOGIES. The interim remedial action utilized must meet all applicable or relevant and appropriate requirements (ARARs) of local, State, and Federal Regulations. It must also be technically feasible, constructable, minimize or prevent any threat to the public, health or environment and be cost effective.

7.1.a. Free Floating Fuel Removal. This technology would satisfy all of the requirements mentioned in the paragraph above, as well as reduce the volume and mobility of the source of the BTX contaminated groundwater.

7.1.b. Fuel Vapor Removal. Vapor extraction above the water surface will increase the rate of free floating fuel removal, and prevent fuel vapors from entering utility line trenches or buildings in the area. It satisfies all of the above requirements and will reduce the time to remediate the site when used in conjunction with fuel removal.

7.1.c. Capping of the North Tank Area. This technology would only apply to 35 percent of the site area since 65 percent is currently covered by the building or pavement. Capping would reduce the amount of rainwater that could percolate into the site. However, since the near surface soil currently has a 2 to 3 foot layer of relatively low permeable clay, this would have a very negligible effect on preventing percolation from reaching the fuel plume. The fuel contaminated soil is at or below the water table. Therefore, rainwater percolation is not adding to the amount of contaminated groundwater. This technology would not be cost effective for the possible benefit.

7.1.d. Removing the Fuel Contaminated Soil. Most of the fuel contaminated soil is just above or below the water table. The soil contamination will be reduced when the vapor extraction system removes the volatiles above the water table and when the water table is lowered, it will also remove fuel below the water table. Therefore, removal of the soil is not necessary and would expose workers as well as the environment to uncontrolled vapor.

7.1.e. Collecting and treating the BTX Contaminated Groundwater. This will be accomplished as part of the Building 3001 RA. The BTX plume is wholely encompassed within the perched aquifer TCE plume that is addressed in the Building 3001 FS, (COE 1988). Therefore, it is not necessary to implement this technology at this site separate from the Building 3001 RA.

7.1.f. Tank Abandonment. The tanks must be properly abandoned to meet the ARARs.

7.2. RECOMMENDED TECHNOLOGY. The interim RA at this site includes free floating fuel recovery, vapor extraction, and tank abandonment. This interim RA has been designed and will be implemented prior to the Building 3001 groundwater collection and treatment. The recommended interim RA would meet listed requirements and remediate the source of the contamination at the site.

8.0 INTERIM ACTION FOR REMOVAL OF PHASE SEPARATED HYDROCARBONS. The recovery options capable of fuel removal have been classified into three broad categories (ref. 2). These are total fluid recovery, hydrocarbon only system, and dual fluid production.

8.1 OPTIONS FOR FUEL RECOVERY.

8.1.a. Total Fluid Recovery. This method brings all the fluid in the well to the surface. Phase separated hydrocarbons are produced along with emulsified liquids which must be treated on the surface. This option requires expensive monitoring and maintenance.

8.1.b. Hydrocarbon Only System. This method uses a pump which only produces phase separated hydrocarbons. It is useful in areas with thick layers of phase separated hydrocarbons. This method usually cannot be used efficiently in areas of low permeability.

8.1.c. Dual Fluid Production. This method uses a water table depression pump to create a cone of depression in the water table which causes the phase separated hydrocarbons to migrate to this cone. A hydrocarbon only pump is then used to recover the phase separated hydrocarbons.

8.2 RECOMMENDATIONS

8.2.a. Total Fluid Recovery. The total fluid recovery method was eliminated because of the difficulty in separation of emulsified fluids and the size of the phase separated hydrocarbon plume (ref. 2).

8.2.b. Hydrocarbon Only System. The hydrocarbon only system was considered but not selected due to the limited ability of the hydrocarbon only pump to continue fuel removal once the phase separated hydrocarbon thickness is lowered.

8.2.c. Dual Fluid Production. The dual fluid production method has been recommended to allow a cone of depression to be created without producing large volumes of groundwater (ref. 2). The cone of depression is formed by lowering the elevation of the groundwater at the well to cause the floating fuel to flow to the well by gravitational forces. The design calls for three 8" diameter wells located in the positions shown on Figure 5. Non-slotted casing would be used from the surface to 5 feet below grade. A 0.020 slot will be used from 5 feet to the bottom of the well at 34 feet below grade (ref. 5). In primary removal, the hydrocarbon only pump will be used alone. In secondary removal of the hydrocarbons, once the thickness is too low for primary removal, the hydrocarbon only pump will be used in combination with the water table depression pump to force fuel to well. The water produced would be treated as a part of the Building 3001 remedial action.

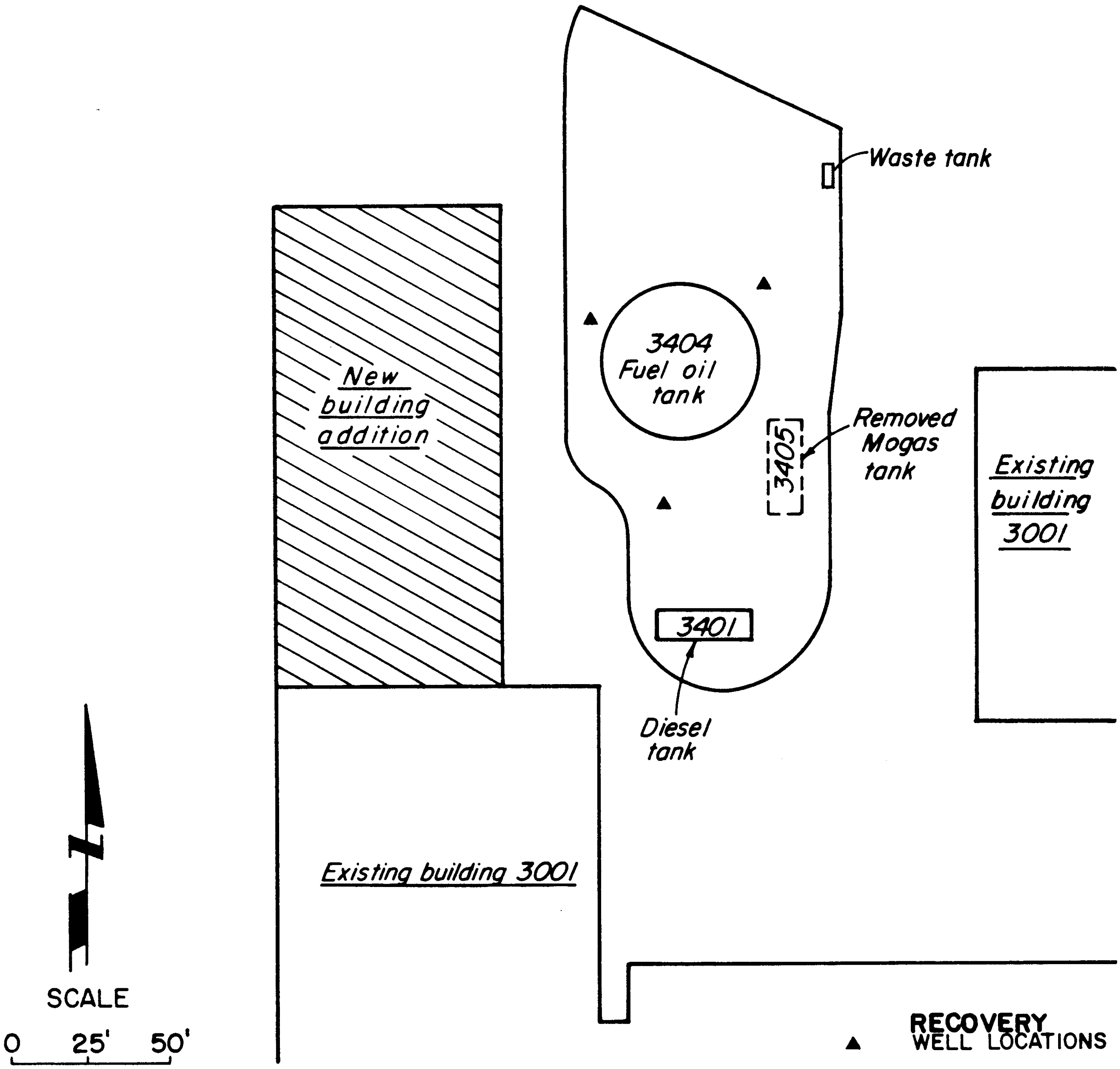


FIGURE 5
RECOVERY WELL LOCATIONS
TINKER AFB

8.3 RECOMMENDED DESIGN FOR PHASE SEPARATED HYDROCARBON REMOVAL. The Probe Scavenger, Oil Recovery Systems Model 1021004, or equal will be used as the hydrocarbon only pump. During primary removal, the recovered phase separated hydrocarbons will be pumped from the well to a surface tank which will be emptied when necessary. A telecommunication system will be installed to notify the Base engineer that the storage tank is full. Tinker maintenance would empty the tank and dispose, use, or sell the fuel. The water table depression pump will be installed at such a time when static recovery of the phase separated hydrocarbons no longer creates a sufficient cone of depression to drive hydrocarbons to the recovery well (secondary removal). The water produced would be treated as a part of the Building 3001 final remedial action. The two recovery wells to the west and south of Tank 3404 will be enclosed in a concrete vault. The vaults will be vented via piping to a thermal combustor described on the following page. Figure 6 shows a schematic drawing of the recovery system including the water pump for secondary removal of hydrocarbons.

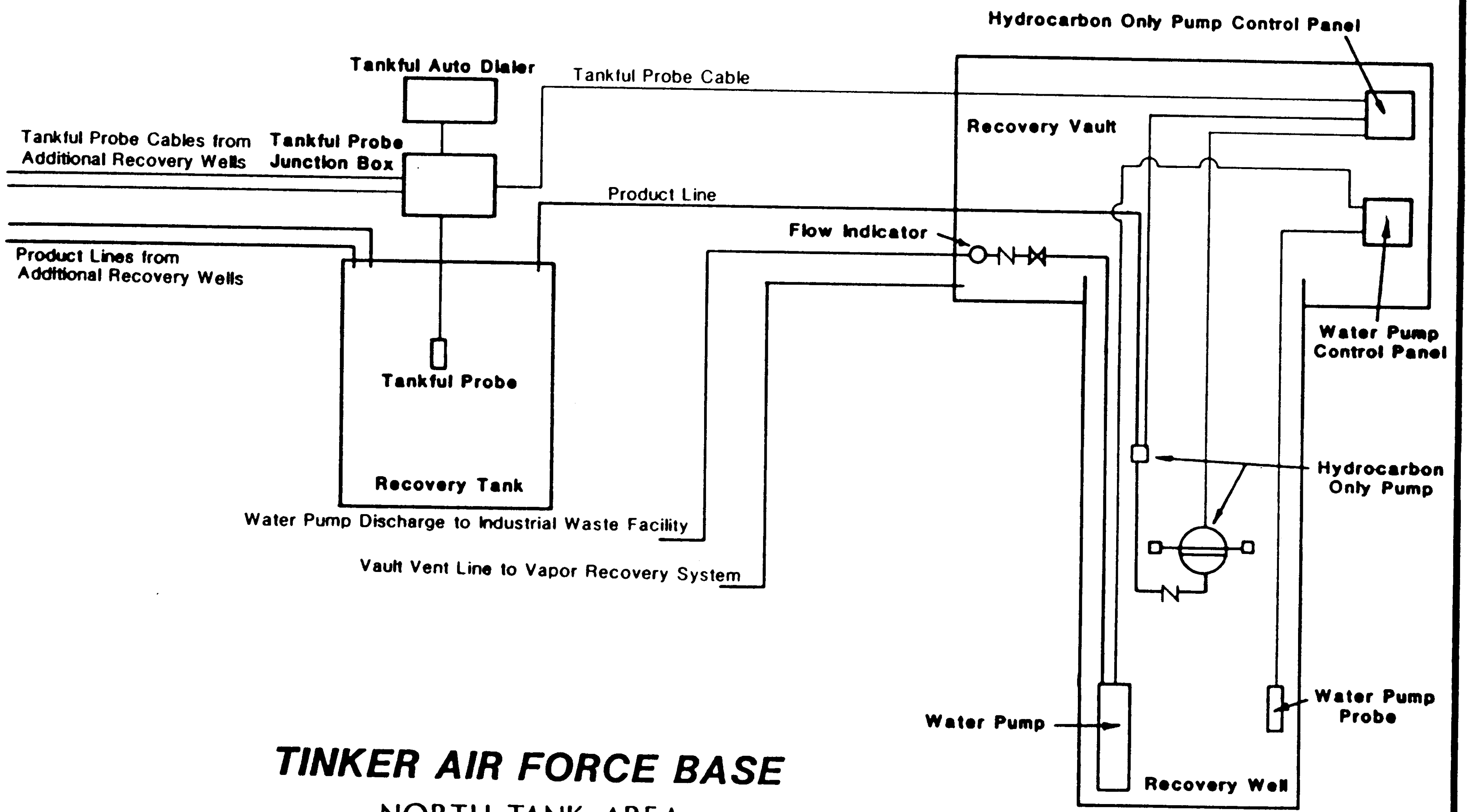
9.0 INTERIM ACTION FOR REMOVAL OF VAPOR PHASE HYDROCARBONS. Several vapor extraction systems have been considered. These systems are discussed below.

9.1 OPTIONS FOR VAPOR PHASE REMOVAL.

9.1.a. Vertical Extraction Wells. The original conceptual design consisted of 100 vapor extraction wells distributed throughout the area (ref. 2). The wells were to be spaced on 30 feet centers, with 20 wells connected to one vacuum blower by manifold piping.

9.1.b. Horizontal Extraction Wells. This option uses horizontal borings through the area of contamination (ref. 4). The use of four horizontal extraction wells was considered. After re-evaluating the design, two horizontal extraction wells with a diameter of 3.5 inches and located 1 foot above the water table were considered. The wells would enter and exit the subsurface at a slant and be connected to blowers for air circulation.

9.1.c. Horizontal Extraction Wells Extending Radially Out of Tank 3404. This option uses horizontal extraction wells which enter the subsurface from inside tank 3404. The wells will have a diameter of 4 inches and will be located 1 foot above the water table.



TINKER AIR FORCE BASE

NORTH TANK AREA

SCHEMATIC DRAWING of
PHASE SEPARATED HYDROCARBON RECOVERY SYSTEM

FIGURE 6
TINKER AFB

9.2 RECOMMENDATIONS.

9.2.a. Vertical Extraction Wells. A vapor pump test was conducted in the area. The test data suggest that the effective radius of influence from a single extraction well is limited to a distance less than 20 feet. (ref. 3). Therefore, additional extraction wells would be required. The number of wells would be prohibitive to the area, therefore, other technologies to vapor recovery were investigated.

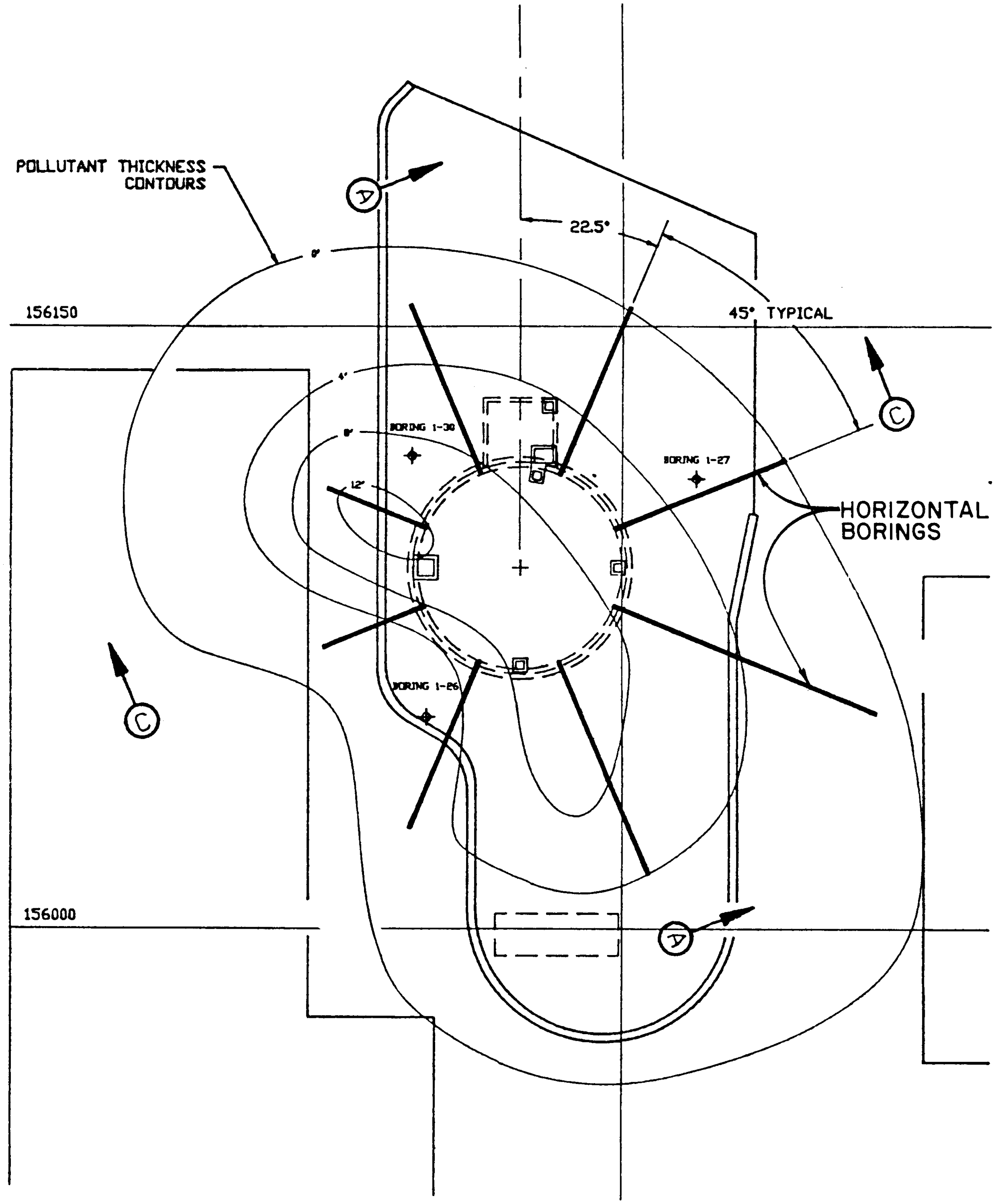
9.2.b. Horizontal Extraction Wells. The use of four horizontal extraction wells would cause problems with existing pipelines and utility line conduits. In many areas the borings would be required to go below the water table which would not aid in vapor removal. The use of horizontal extraction wells entering through the surface would require welded steel casing because of the inadequate tensile strength of PVC pipe, therefore increasing the cost significantly. Two horizontal extraction wells located on the edges of the contamination would not interfere with existing structures but would have a reduced area of influence.

9.2.c. Horizontal Extraction Wells Extending Radially Out of Tank 3404. This option would use Tank 3404 as an asset rather than a restriction. The entire boring would be located within 1 foot of the water table and not enter from the surface. The area of influence would nearly cover the area of the floating fuel plume.

9.3 RECOMMENDED VAPOR EXTRACTION DESIGN. The vapor extraction system would consist of 360 feet of 4 inch horizontal borings. The 360 feet of boring would be distributed to the 8 borings as shown in Figure 7. Cross sections of Tank 3404 including the recommended vapor recovery lines are shown in Figure 8. The borings have a horizontal spacing of 55 feet at 70 feet from the center, the main radius of the fuel plume, of tank 3404. This design would remove the fuel vapor in 3 years under normal operation. A blower and a back up blower would be connected to the 4" PVC pipe in the horizontal borings. Valves would be connected to each boring to control vapor flow.

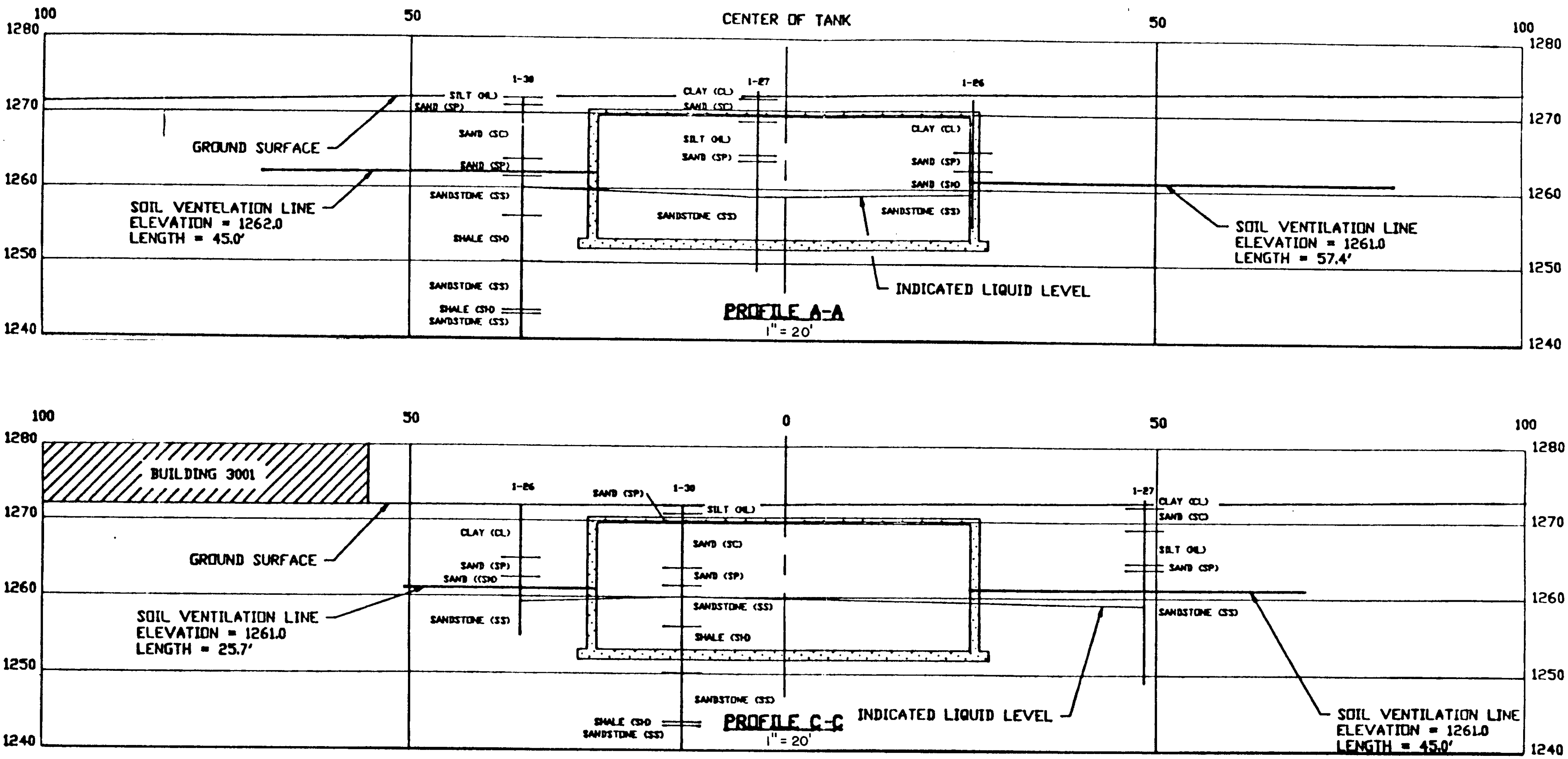
10.0 THERMAL COMBUSTOR. The hydrocarbon vapor from the soil and the vaults would be vented to a thermal combustor. The John Zink Series GV-ZTOF Smokeless, Total Enclosed, Natural Draft, Air Assisted Combustor, or equal, would be used to burn the hydrocarbon vapor. The combustor has a Volatile Organic Carbon destruction efficiency of 95%. An alarm system will be installed to notify emergency personnel (Fire Station) in the event of any problems. The combustor is equipped with an emergency shutdown device.

NORTH TANK AREA OPERABLE UNIT
FOR
FUEL THICKNESS AND VAPOR RECOVERY LINES



1" = 40'

FIGURE 7
TINKER AFB



NORTH TANK AREA OPERABLE UNIT

CROSS SECTIONS SHOWING VAPOR RECOVERY LINES

FIGURE 8
TINKER AFB

11.0 TANK ABANDONMENT. Tank 3404 and the small underground waste tank would have been abandoned, demolished, and backfilled. However, due to the use of Tank 3404 for the horizontal borings in the vapor recovery system, the tanks would not be abandoned, demolished, or backfilled until the vapor phase recovery is complete. After vapor recovery is complete, the tanks would be backfilled with satisfactory material consisting of any material classified as SW, SC, SP, SM, and GC according tothe Unified Soil Classification System. Fill materials would be placed in 1 foot lifts and compacted with tamping machines or vibratory machines. The surface equipment for the tanks would also be demolished and removed from the area when the interim remedial action is complete.

12.0 SUMMARY OF RECOMMENDED TECHNOLOGIES. The recommended technologies for this site include dual fluid production for phase separated hydrocarbon removal, horizontal extraction wells extending radially from Tank 3404 for removal of vapor phase hydrocarbons, tank abandonment, and treatment of the groundwater with Building 3001 groundwater treatment. The phase separated hydrocarbon removal would be accomplished by the use of a hydrocarbon only pump and a water table depression pump when necessary. The vapor phase removal would be accomplished by the use of 8 horizontal extraction wells extending radially out of Tank 3404. Tank abandonment would be completed once the removal of fuel vapor is complete. The tanks would be abandoned, cleaned, demolished, and backfilled with soil. These technologies will provide sufficient removal of the contamination in the area.

References

1. Burke Engineers, Inc., A. L., "Investigation of Underground Storage Tanks", Tinker Air Force Base, Oklahoma, (Report prepared for Department of the Air Force, Air Logistics Center, Tinker Air Force Base, Contract No. F34650-85-c-0238), July 1986.

2. Groundwater Technology, Inc., "Hydrocarbon Abatement Proposal, North Fuel Tank Area", Tinker Air Force Base, Oklahoma, (Report prepared for Department of the Army, Corps of Engineers, Tulsa District), June 1988.

3. Groundwater Technology, Inc., "Soil Vent Test, North Tank Area", Tinker Air Force Base, Oklahoma, (Report prepared for Triax, Inc.), August 1989.

4. Groundwater Technology, Inc., "Adsorbed Phase, Remedial Design, North Tank Farm", Tinker Air Force Base, Oklahoma, (Report prepared for Triax, Inc., submitted to Department of the Army, Corps of Engineers, Tulsa District), September 1989.

5. Triax, Inc., "Early Preliminary Design, North Tank Area", Tinker Air Force Base, Oklahoma, (Report prepared for Department of the Army, Corps of Engineers, Tulsa District, Contract No. DACA56-87-D-0042), September 1988.

6. U.S. Army Corps of Engineers, Tulsa District, "Building 3001 Remedial Investigations", Tinker Air Force Base, Oklahoma, January 1988.

7. U.S. Army Corps of Engineers, Tulsa District, "Building 3001 Risk Assessment" Tinker Air Force Base, Oklahoma, August 1988.

8. U.S. Army Corps of Engineers, Tulsa District, "Building 3001 Feasibility Study", Tinker Air Force Base, Oklahoma, August 1989.

9. U.S. Army Corps of Engineers, Tulsa District, "Building 3001 Proposed Plan", Tinker Air Force Base, Oklahoma, January 1990.